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IMPROVED VISOR MATERIAL FOR DPE OUTERGARMENT.(U)
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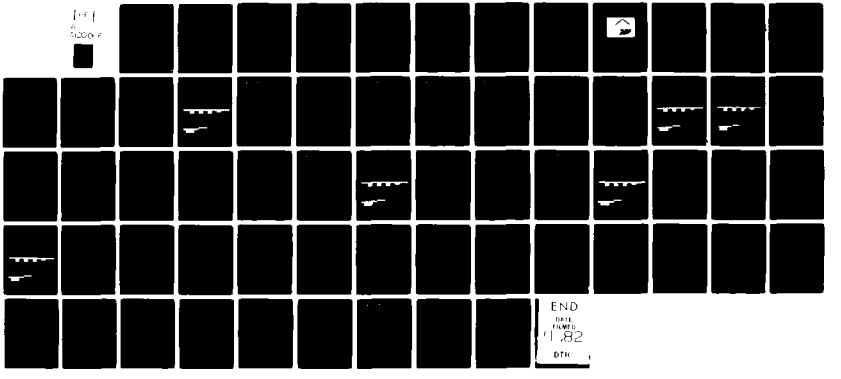

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CHEMICAL SYSTEMS LABORATORY CONTRACTOR REPORT

IMPROVED VISOR MATERIAL FOR DPE OUTERGARMENT
FINAL REPORT

January 1982

ILC DOVER
Box 366
Frederica, DE 19946

Contract No. DAAK11-79-C-0066
Task Order Number 10

The view, opinions, and/or findings contained in this report are those of the author and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER DAAK11-79-C-0066-10	2. GOVT ACCESSION NO. AD-A120 066	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Improved Visor Material for DPE Outergarment		5. TYPE OF REPORT & PERIOD COVERED Final Report 07/14/80 - 01/22/82 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Robert Algera, Program Manager Rrotective Equipment, ILC Dover		8. CONTRACT OR GRANT NUMBER(s) DAAK11-79-C-0066
9. PERFORMING ORGANIZATION NAME AND ADDRESS ILC DOVER P.O. Box 266 Frederica, DE 19946		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Task Order No. 10
11. CONTROLLING OFFICE NAME AND ADDRESS CDR, ARRADCOM CML/Ballistics Procurement APG (Edgewood Area) MD 21010		12. REPORT DATE 22 January, 1982 13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) DCASR, Philadelphia P.O. Box 7730 Philadelphia, PA 19101		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/ DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release, distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Demilitarization Protective Ensemble (DPE)
Outergarment
Visor Material

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This task was authorized to investigate alternative materials for the current PVC visor of the DPE Outergarment that will increase the shelf life of Outergarment without affecting its protective capability. A material search and test program isolated an Ionomer (Surlyn) as the improved material for the visor, and a functional test program verified the suitability of Surlyn as the visor material in the DPE Outergarment.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

TABLE OF CONTENTS

IMPROVED VISOR MATERIAL FOR DPE OUTERGARMENT

1. INTRODUCTION

The current DPE outergarment visor material is polyvinyl chloride (PVC) compounded with a significant amount of plasticizer to increase the flexibility of the PVC. However, during long periods of storage, the plasticizer was found to migrate from the PVC to the chlorinated polyethylene (CPE) material of the outergarment, thus reducing the flexibility of the visor to an unacceptable level. The rate of the migration of the plasticizer limits the shelf life of the DPE outergarment to one year. This program was funded to investigate alternative visor materials that will increase the shelf life of the DPE outergarment without affecting its protective capability.

2. INVESTIGATIONAL PROCEDURES AND RESULTS

Task procedures of this program included the following:

- °A materials search to identify alternative materials that would achieve the goals of the program.
- °A test program to screen the material candidates consisting of physical properties testing.
- °Development of manufacturing and assembly techniques to ensure that any of the selected materials could be constructed as the CPE visor.
- °A functional test program to verify that the final selected material was suitable for the DPE outergarment application.

The materials search effort and screening test program resulted in the selection of an ionomer (Surlyn) as the improved DPE visor material. The new visor was constructed as a subassembly to facilitate manufacturing. The functional test program verified that Surlyn is a suitable material to replace PVC as the DPE outergarment visor.

3. MATERIALS INVESTIGATION

The materials investigation consisted of a search to identify material candidates, procurement of samples for screening testing, and testing of the physical properties of the samples as they apply to the DPE outergarment visor.

3.1 MATERIALS SEARCH

The materials search consisted of a study of all thermoplastic elastomeric materials currently available. Research involved a literature survey of material vendor product bulletins and data sheets, telephone conversations with material vendors, and intensive study of research journals on elastomeric materials. The materials search resulted in the selection of the following material candidates to be subjected to physical property testing:

- °Ionomer (Surlyn)
- °Cellulose Acetate
- °Cellulose Butyrate
- °Chlorotrifluoroethylene (KEL-F)
- °Low Density Polyethylene/Barex coextrusion
- °Styrene Butadiene (Solprene)
- °Thermoplastic Polyester

3.2 MATERIAL TEST PROGRAM

Samples of the above material candidates were procured and subjected to physical properites testing as specified in DD500-S00008 - Material Specification For Press Polished Optical Grade Vinyl Sheet. The results of the test program are given in Table I. The physical property test data sheets are included in Attachment 1. As is seen in Table I, Surlyn is the only one of the material candidates that meets all of the requirements of the material specification. Additionally, Surlyn contains no plasticizers which could migrate to the CPE as is the case with the PVC visor. Therefore, Surlyn was selected for further investigation as the improved DPE visor material.

4. FABRICATION AND ASSEMBLY TECHNIQUES

In conjunction with the materials investigation, an effort to develop the optimum fabrication and assembly techniques with the new visor materials was initiated. Since it was noted early in the test program that Surlyn was the most likely candidate, effort was concentrated on developing techniques for using Surlyn.

4.1 VISOR SEAMS

Current DPE fabrication procedures call for the visor to be sealed to itself by RF sealing. When this technique was tried with the Surlyn, the seams were found to have unsatisfactory strength. In order to improve the seam strength, the following technique was developed:

TABLE I
PHYSICAL PROPERTIES TESTING
OF DPE VISOR MATERIAL CANDIDATES

PROPERTY	REQ'T	PVC	SURLYN	ACETATE	LDPE/ BAREX	PET	KEL-F	SOLPRENE
TENSILE	2800 psi min	3230	4018	5187	6382	7491	5200	2100
ELONGATION	250% min	424	792	85	64	20	180	940
TEAR	550 #/in min	700	838	584	816	1210		180
COLD CRACK	pass at -20°C	pass	pass	fail	fail	fail		
ABRASION	TBD	.094 GMS lost	.077 GMS lost					
BLOCKING	SL. B.	SL. B.	SL. B.					
ACCEL AGING	TBD	no changes	no changes					
SEAM STRENGTH	16 #/in min		47.6 #/in					
SEAM STRENGTH AFTER ACCEL AGING	16 #/in min		27.3 #/in					

a) Prepare surlyn by roughing with sandpaper in area to be sealed.

b) Apply adhesive (Bostik 7376 and Boscodur #4 two part system) in area to be sealed.

c) Air cure adhesive for a minimum of 8 hours.

d) Place the surlyn between two pieces of .002" thick PVC film and apply power.

e) Peel PVC film away from surlyn after sealing.

The strength of the seams made per the above procedure was higher than is required by the material specification, however the power requirements are higher than normal and there is a possibility of arcing across the heat seal tool due to the high power, which is a danger to the operator and requires reworking the tool if the arcing damages it. This arcing also normally damages the Outergarment, thus requiring rework or scraping the unit.

In order to eliminate the problems associated with sealing surlyn to itself, the helmet was redesigned as a separate subassembly as shown in Figure 1. The advantage of this approach is that all seams in the helmet assembly are either Surlyn to CPE, or CPE to CPE. The procedure for sealing the Surlyn to CPE is:

a) Prepare Surlyn by roughing with sandpaper in area to be sealed.

b) Apply adhesive (Bostik 7376 and Boscodur #4 two part system) in area to be sealed.

c) Air cure adhesive for a minimum of 8 hours.

d) Heat seal Surlyn to CPE

The shear strength of seams prepared in this manner averaged 47.6 #/in, well above the specification requirement of 30 #/in.

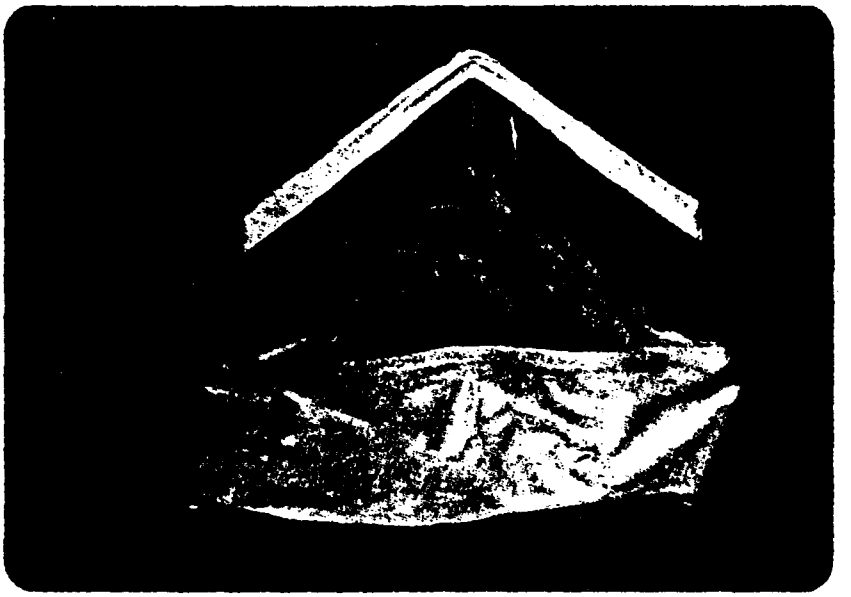

FIGURE 2 - DPE HELMET WITH

CPE FLANGE AROUND PERIPHERY

A further advantage to fabricating the helmet as a spearate subassembly is that the helmet can be fabricated and handled separately from the body of the outergarment which reduces the amount of handling and facilities area required for curing the adhesive system, thus keeping the manufacturing costs associated with the installation of the Surlyn visor at a minimum.

5. FUNCTIONAL TEST PROGRAM

The functional test program was run to verify that the Surlyn would be suitable in the DPE Outergarment configuration. The elements of the functional testing were a burst test, an endurance test, and an impact test. The functional test program test data sheets are included in Attachment 2.

The burst test determines the seam that is stressed the greatest under pressure loading. The procedure followed during the burst test is to seal the Outergarment exhaust assembly, and pressurize the suit until failure occurs. The pressurized Outergarment failed at 21 iwg at the left shoulder seam. Failure of a DPE Outergarment normally occurs between 18 and 22 iwg. Therefore, the Surlyn visor seams are not expected to be the highest stressed in the DPE Outergarment.

The endurance test was run to ensure that a DPE Outergarment with a Surlyn visor will endure the two hour use cycle employed at CAMDS. The test procedure used during the endurance test is outlined in Table II. The endurance test was run for a total of six hours with no leakage or other problems occuring in the visor area. However, on two occassions the Outergarment tore at the tail section. This was most likely caused by a

combination of the air pack pressing against this area and the reduction in volume and corresponding increase in pressure caused by the "duck squat" portion of the endurance test. It is also possible that the pressure relief valves did not operate during this maneuver as the subject had his arms folded across his chest in the area of the pressure relief valves.

The impact test was run to verify that a Surlyn visor can withstand repeated impacts without degradation. The impact test procedure consists of placing a helmet assembly in a fixture and pressurizing it to normal working pressure. A mechanical test fixture is then used to impact the visor at its peak with a force of 13.5 pounds at a rate of 200 impacts per minute. The test fixture is set up so that the visor deflects approximately one inch upon impact. The impact test was concluded after 2000 impacts with no leakage or damage found to the visor.

6. DISCUSSION OF RESULTS

Performance of this contract resulted in the selection of .020 inch thick Surlyn as an improved visor material for the CPE outergarment. Selection was based on the ability of the material to increase the shelf life of the ensemble while at the same time conform to all visor specification requirements. Other selection criteria included material availability, manufacturing considerations, and cost effectiveness.

One characteristic of the Surlyn that needs to be improved is that of its optical quality, which is of course a critical parameter in a visor application. The Surlyn samples originally received had excellent optics (93%

Light Transmission, 2% Haze). However, the material procured for the fabrication of the evaluation units of this program had values of 92% Light Transmission and 5.2% Haze, which is above the 4.0 maximum haze requirement. Contact with the Surlyn film supplier revealed that the resin supplier was forced to modify the Surlyn formulation slightly to conform to environmental regulations. This change caused processing difficulties for the material converter, causing the increase in haze due to the addition of processing aids.

Normal procedure to improve the optics of a clear material involves press polishing. This consists of placing the material between two perfectly smooth (polished) surfaces, and heating and applying pressure to the material until it begins to flow, thus removing surface imperfections which distort the light and increase haze values. Conventional press polishing operators however, are reluctant to polish Surlyn due to its affinity for metal at elevated temperatures and the possibility of ruining an expensive set of polished platens. ILC has developed a technique for press polishing Surlyn, however our current press is too small (12" X 16") to polish the entire DPE Outergarment visor. ILC is currently in the process of procuring and installing a larger press that will accomodate the DPE visor size so that a Surlyn visor for the DPE Outergarment can be press polished in the future.

A second concern that has arisen with the Surlyn visor material is its applicability to high volume production. The bonding and sealing procedure described in section 4.1 resulted in seam strengths greater than the specification requirement when done on a prototype basis. However, when the 30

evaluation garments were fabricated, a high percentage of the visor seams were found to have peeled away from the visor thus necessitating a great deal of rework not previously encountered in the manufacture of DPE Outergarments. In order to reduce this amount of rework to economically practical levels, further investigation into improving the sealing techniques, such as Corona Discharge treatment of the Surlyn prior to bonding must be done.

7. RECOMMENDATIONS

In order to make the Surlyn material feasible for high volume production, ILC Dover recommends that further areas of development be considered:

1.) Development of the press polishing procedure for Surlyn of a size large enough for the DPE outergarment visor.

2.) Investigation of improvement of the current bonding and sealing techniques for cost effective production.

ILC Dover also recommends that after completion of the above areas of development, specification DD500-S00008 be changed to reflect .020" thick Surlyn as the DPE outergarment visor material. Since the Surlyn is sufficiently flexible enough at this thickness without the addition of plasticizers, the shelf life of the DPE will not be limited due to plasticizer migration from the visor. In addition, the superior physical properties of the Surlyn will result in an overall product improvement to the DPE outergarment. Because the Surlyn meets or exceeds all of the current requirements of the visor specification, no other changes are required.

ATTACHMENT 1

PHYSICAL PROPERTY TEST DATA SHEETS

ILC DOVER

BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 05X-1 0339-01

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED DPE VISOR MATERIAL	X29-893-X00	12/04/80

4. TITLE	5. ARTICLE DESCRIPTION
MATERIAL EVALUATION	Surlyn 1605

6. TEST DESCRIPTION

Tensile strength per FED-STD-406, Method 1013
Elongation per FED-STD-406, Method 1013
Tear per FED-STD-406, Method 1121

7. TEST PROCEDURE ATTACHED ☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED ☐ YES ☒ NO

9. DATE RESULTS NEEDED 12/19/80

10. ORIGINATOR Bob Algera

TEST COORDINATOR

PRIORITY	WITNESS	YES	NO
	Originator		
	Coordinator		

TEST LEVEL			

COMMENTS

Q & R REVIEW

Q&R WITNESS ☒ YES ☐ NO

DCASR WITNESS ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION ☒ YES ☐ NO

COMMENTS

Reviewed By	Date

TEST CONDUCTOR

SCHEDULE	APPROVAL	
	TC	Q&R
DATE		
TIME		

COMMENTS

FORM NO 2013 (9/79) White - Test Lab Yellow - Test Lab Pink - Originator PRINTED IN USA

ILC DOVER BOX 266 - FREDERICA, DE. 19946	TEST RESULTS	TEST NUMBER 05X-1 0339-01
PROJECT NAME Improved Visor Material	CHARGE NUMBER X29-893-500	DATE 12/04/80
TEST EQUIPMENT USED Instron	CALIBRATION OF TEST EQUIPMENT VERIFIED BY	DATE

PHYSICAL TEST REPORT

IDENTIFICATION: Surlyn 1605

CURE DATE:

	GAUGE	MODULUS						ULTIMATE TENSILE		ULTIMATE ELONGATION
	MILS	FORCE	PSI	FORCE	PSI	FORCE	PSI	FORCE	PSI	(%)
1	20.4							69	3382	680
2	21.2							72	3396	720
3	20.9							61	2919	560
4	20.9							69	3301	680
5	20.7							68	3285	680
AVG.									3257	664
REQD.										

COMMENTS

	GAUGE	TEAR RESISTANCE		DUROMETER SHORE "A"		TENSION SET	
	MILS	FORCE	PPI				
1	20.9	13	619	LEFT		1	
2	20.9	14	670	RIGHT		2	
3	20.3	12.6	621			3	
				REQD.		4	
AVG.			637			5	
REQD.							

ENVIRONMENT DURING TEST

DATA APPROVED BY

NAME	TITLE	DATE

RESULTS RECORDED BY

ILC DOVER

BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 05X-1 0252-14

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED VISOR MATERIAL	X29-893-X00	9/08/80

4. TITLE	5. ARTICLE DESCRIPTION
ABRASION	Surlyn 1605

6. TEST DESCRIPTION

Per FED-STD-406, Method 1091, (Taber) H-18 Wheel, 1000 gm WT, 500 cycles

7. TEST PROCEDURE ATTACHED: ☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED: ☐ YES ☒ NO

9. DATE RESULTS NEEDED: 9/12/80

10. ORIGINATOR: Bob Algera

TEST COORDINATOR

PRIORITY	WITNESS	YES	NO
	Originator		
	Coordinator		
TEST LEVEL			

COMMENTS

Q & R REVIEW

Q&R WITNESS: ☒ YES ☐ NO

DCASR WITNESS: ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION: ☒ YES ☐ NO

COMMENTS

Reviewed By	Date

TEST CONDUCTOR

SCHEDULE	APPROVAL TC	APPROVAL Q&R
DATE		
TIME		

COMMENTS

FORM RD 2012 (9/79) White - Test Lab Yellow - Test Lab Pink - Originator PRINTED IN USA

ILC DOVER
BOX 266 - FREDERICA, DE. 19946

TEST RESULTS	TEST NUMBER
	05X-1 0252-14

PROJECT NAME	CHARGE NUMBER	DATE
Visor Material	029-893-500	9/08/80

TEST EQUIPMENT USED	CALIBRATION OF TEST EQUIPMENT	
	VERIFIED BY	DATE
Taber Abrasor		

Surlyn

H-18 wheels - 500 cycles - 1000 gms. weight

Weight loss - .07663 gms.

ENVIRONMENT DURING TEST

50 % Relitivie Humidity 75 Degrees F.

RESULTS RECORDED BY

DATA APPROVED BY

NAME	TITLE	DATE

ILC DOVER

BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 05X-1 0253-11

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED VISOR MATERIAL	X29-893-X00	09/08/80

4. TITLE	5. ARTICLE DESCRIPTION
BLOCKING	Surlyn 1605

6. TEST DESCRIPTION

Per FED-STD-406, Method 1131

Test Temp. 140°F

7. TEST PROCEDURE ATTACHED ☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED ☐ YES ☒ NO

9. DATE RESULTS NEEDED 9/12/80

10 ORIGINATOR Bob Algera

TEST COORDINATOR

PRIORITY	WITNESS	YES	NO
	Originator		
	Coordinator		
TEST LEVEL			

COMMENTS

Q & R REVIEW

Q&R WITNESS ☒ YES ☐ NO

DCASR WITNESS ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION ☒ YES ☐ NO

COMMENTS

Reviewed By	Date

TEST CONDUCTOR

SCHEDULE	APPROVAL	
	TC	Q&R
DATE		
TIME		

COMMENTS

FORM NO 2013 (9/79) White - Test Lab Yellow - Test Lab Pink - Originator PRINTED IN USA

ILC DOVER BOX 266 - FREDERICA, DE. 19946	TEST RESULTS	TEST NUMBER 05X-1 0252-11
PROJECT NAME	CHARGE NUMBER	DATE
Visor	X29-893-500	9/09/80
TEST EQUIPMENT USED	CALIBRATION OF TEST EQUIPMENT VERIFIED BY	DATE
Blue "M" Oven		

Blocking Test (Surlyn)

Samples sustained slight blocking (Degree SL. B as reported per spec.) No surface damage, however samples had to be peeled apart.

ENVIRONMENT DURING TEST

DATA APPROVED BY

NAME TITLE DATE

RESULTS RECORDED BY

FORM NO. [illegible]

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ILC DOVER
BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 05X-1 0252-06

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED VISOR MATERIAL	X29-893-X00	9/09/80

4. TITLE	5. ARTICLE DESCRIPTION
ACCELERATED STORAGE	Surlyn 1605

6. TEST DESCRIPTION

Test per FED-STD0406, Method 6011, Procedure VII

7. TEST PROCEDURE ATTACHED ☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED ☐ YES ☒ NO

9. DATE RESULTS NEEDED: 9/12/80

10. ORIGINATOR: Bob Algera

TEST COORDINATOR

PRIORITY	WITNESS	YES	NO
	Originator		
	Coordinator		
TEST LEVEL			

COMMENTS

Q & R REVIEW

Q&R WITNESS ☒ YES ☐ NO

DCASR WITNESS ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION ☒ YES ☐ NO

COMMENTS

Reviewed By	Date

TEST CONDUCTOR

SCHEDULE	APPROVAL	
	TC	Q&R
DATE		
TIME		

COMMENTS

FORM NO 2013 (9/79) White - Test Lab Yellow - Test Lab Pink - Originator PRINTED IN USA

ILC DOVER BOX 266 - FREDERICA, DE. 19946	TEST RESULTS	TEST NUMBER 05X-1 0252-06
PROJECT NAME Visor	CHARGE NUMBER X29-893-500	DATE 9/10/80
TEST EQUIPMENT USED As Required.	CALIBRATION OF TEST EQUIPMENT VERIFIED BY	DATE

Surlyn

Weight before - 9.376 oz/yd^2

Weight after aging - 9.349 oz/yd^2

Thickness before - 38.8 mils

Thickness after aging - 38.4 mils

No color change, surface irreguarities, oder, or alterations of shape. No dimensional changes

ENVIRONMENT DURING TEST

DATA APPROVED BY

NAME	TITLE	DATE

RESULTS RECORDED BY

FORM NO. [illegible]

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ILC DOVER
BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 03A-1 0232-04

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED VISOR MATERIAL	X29-893-X00	8/19/80

4. TITLE	5. ARTICLE DESCRIPTION
MATERIAL EVALUATION	PVC (ST91R001)

6. TEST DESCRIPTION

Tensile strength per FED-STD-406, Method 1013
Elongation per FED-STD-406, Method 1013
Tear Resistance per FED-STD-406, Method 1121

7. TEST PROCEDURE ATTACHED: ☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED: ☐ YES ☒ NO

9. DATE RESULTS NEEDED: 8/29/80

10 ORIGINATOR: Bob Algera

TEST COORDINATOR

PRIORITY	WITNESS	YES	NO
	Originator		
	Coordinator		
TEST LEVEL			

COMMENTS

Q & R REVIEW

Q&R WITNESS: ☒ YES ☐ NO

DCASR WITNESS: ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION: ☒ YES ☐ NO

COMMENTS

Reviewed By	Date

TEST CONDUCTOR

SCHEDULE	APPROVAL	
	TC	Q&R
DATE		
TIME		

COMMENTS

FORM NO 2013 (9/79) White - Test Lab Yellow - Test Lab Pink - Originator PRINTED IN USA

ILC DOVER BOX 266 - FREDERICA, DE. 19946	TEST RESULTS	TEST NUMBER 03A-1 0232-04
PROJECT NAME Visor Material	CHARGE NUMBER 29-893-500	DATE 8/19/80
TEST EQUIPMENT USED Instron	CALIBRATION OF TEST EQUIPMENT VERIFIED BY	DATE

PHYSICAL TEST REPORT

IDENTIFICATION: PVC (Transverse

CURE DATE:

	GAUGE	MODULUS						ULTIMATE TENSILE		ULTIMATE ELONGATION
	MILS	FORCE	PSI	FORCE	PSI	FORCE	PSI	FORCE	PSI	(%)
1	36.0							110	3056	440
2	35.9							112	3120	480
3	35.9							111	3092	460
4	35.8							111	3101	480
5	35.6							112	3146	480
AVG.									3103	468
REQD.										

COMMENTS

	GAUGE	TEAR RESISTANCE		DUROMETER SHORE "A"		TENSION SET	
	MILS	FORCE	PPI				
1	36.0	25	694	LEFT		1	
2	35.7	23.5	658	RIGHT		2	
3	35.6	23	646			3	
				REQD.		4	
AVG.			666			5	
REQD.							

ENVIRONMENT DURING TEST

RESULTS RECORDED BY

DATA APPROVED BY

NAME	TITLE	DATE

ILC DOVER
BOX 266-FREDERICA, DE. 19946

TEST RESULTS

TEST NUMBER: 03A-1
0232-04

PROJECT NAME: Visor Material

CHARGE NUMBER: 29-893-500

DATE: 8/19/80

TEST EQUIPMENT USED: Instron

CALIBRATION OF TEST EQUIPMENT
VERIFIED BY | DATE

PHYSICAL TEST REPORT

IDENTIFICATION: PVC Machine

CURE DATE:

	GAUGE	MODULUS						ULTIMATE TENSILE		ULTIMATE ELONGATION
	MILS	FORCE	PSI	FORCE	PSI	FORCE	PSI	FORCE	PSI	(%)
1	35.6							116	3258	440
2	36.5							118	3233	400
3	36.0							116	3222	440
4	35.9							118	3287	440
5	40.0							126	3150	400
AVG.									3230	424
REQD.										

COMMENTS

	GAUGE	TEAR RESISTANCE		DUROMETER SHORE "A"		TENSION SET	
	MILS	FORCE	PPI				
1	36.4	25.5	701	LEFT		1	
2	35.9	25.5	710	RIGHT		2	
3	36.3	25	689			3	
				REQD.		4	
AVG.			700			5	
REQD.							

ENVIRONMENT DURING TEST

DATA APPROVED BY
NAME | TITLE | DATE

RESULTS RECORDED BY

ILC DOVER

BOX 266-FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 05X-1 0234-05

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED DPE VISOR MATERIAL	X29-893-X00	8/21/80

4. TITLE	5. ARTICLE DESCRIPTION
COLD CRACK	PVC (ST91R001)

6. TEST DESCRIPTION

Run Cold Crack Test per ASTM-D-1790 at -20°F. If cracks occur, run at -5°F.

7. TEST PROCEDURE ATTACHED ☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED ☐ YES ☒ NO

9. DATE RESULTS NEEDED 8/29/80

10. ORIGINATOR Bob Algera

TEST COORDINATOR

PRIORITY	WITNESS	YES	NO
	Originator		
	Coordinator		

TEST LEVEL			

COMMENTS

Q & R REVIEW

Q&R WITNESS ☒ YES ☐ NO

DCASR WITNESS ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION ☒ YES ☐ NO

COMMENTS

Reviewed By	Date

TEST CONDUCTOR

SCHEDULE	APPROVAL TC	APPROVAL Q&R
DATE		
TIME		

COMMENTS

FORM NO 2013 (8/79) White - Test Lab Yellow - Test Lab Pink - Originator PRINTED IN USA

ILC DOVER BOX 266 - FREDERICA, DE. 19946	TEST RESULTS	TEST NUMBER 05X-1 0234-05
PROJECT NAME Visor Material	CHARGE NUMBER 29-893-500	DATE 8/21/80
TEST EQUIPMENT USED Missimer Chamber	CALIBRATION OF TEST EQUIPMENT VERIFIED BY	DATE

PVC sample failed at -20°F. Secon sample passed @ -5°F. (Creasing but no crack.)

ENVIRONMENT DURING TEST	DATA APPROVED BY NAME	TITLE	DATE
RESULTS RECORDED BY			

FORM NO. [illegible] PRINTED IN USA

ILC DOVER
BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 05X-1 0252-05

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED VISOR MATERIAL	X29-893-X00	9/08/80

4. TITLE	5. ARTICLE DESCRIPTION
ACCELERATED STORAGE	PVC (ST91R001)

6. TEST DESCRIPTION

Test per FED-STD-406, Method 6011, Procedure VII

7. TEST PROCEDURE ATTACHED ☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED ☐ YES ☒ NO

9. DATE RESULTS NEEDED: 9/12/80

10 ORIGINATOR: Bob Algera

TEST COORDINATOR

PRIORITY	WITNESS	YES	NO
	Originator		
	Coordinator		
TEST LEVEL			

COMMENTS

Q & R REVIEW

Q&R WITNESS ☒ YES ☐ NO

DCASR WITNESS ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION ☒ YES ☐ NO

COMMENTS

Reviewed By	Date

TEST CONDUCTOR

SCHEDULE	APPROVAL TC	APPROVAL Q&R
DATE		
TIME		

COMMENTS

FORM NO 2813 (9/79) White - Test Lab Yellow - Test Lab Pink - Originator PRINTED IN USA

ILC DOVER BOX 266 - FREDERICA, DE. 19946	TEST RESULTS	TEST NUMBER 05X-1 0252-05
PROJECT NAME	CHARGE NUMBER	DATE
Visor	X29-893-500	9/10/80
TEST EQUIPMENT USED	CALIBRATION OF TEST EQUIPMENT VERIFIED BY	DATE
As Required		

PVC

Weight before - 11.830

Weight after aging - 11.800

Thickness before - 35.5 mils

Thickness after aging - 35.7 mils

No color change, surface irregularities, oder, or alterations of shape.

No dimensional changes.

ENVIRONMENT DURING TEST	DATA APPROVED BY NAME / TITLE / DATE
RESULTS RECORDED BY	

FORM NO. [illegible]

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ILC DOVER
BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 05X-1 0252-13

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED VISOR MATERIAL	X29-893-X00	9/08/81

4. TITLE	5. ARTICLE DESCRIPTION
ABRASION RESISTANCE	PVC (ST91R001)

6. TEST DESCRIPTION

Abrasion Test per FED-STD-406, Method 1091, (Taber)
H-18 Wheel, 1000 gm weight, 500 cycles

7. TEST PROCEDURE ATTACHED
☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED
☐ YES ☒ NO

9. DATE RESULTS NEEDED
9/12/80

10. ORIGINATOR
Bob Algera

TEST COORDINATOR

PRIORITY	WITNESS	YES	NO
	Originator		
	Coordinator		

TEST LEVEL			

COMMENTS

Q & R REVIEW

Q&R WITNESS ☒ YES ☐ NO

DCASR WITNESS ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION ☒ YES ☐ NO

COMMENTS

Reviewed By	Date

TEST CONDUCTOR

SCHEDULE	APPROVAL TC	APPROVAL Q&R
DATE		
TIME		

COMMENTS

FORM NO 2013 (9/79) White - Test Lab Yellow - Test Lab Pink - Originator PRINTED IN USA

ILC DOVER BOX 266 - FREDERICA, DE. 19946	TEST RESULTS	TEST NUMBER 05X-1 0252-13
PROJECT NAME	CHARGE NUMBER	DATE
Visor Material	29-893-500	09/08/80
TEST EQUIPMENT USED	CALIBRATION OF TEST EQUIPMENT VERIFIED BY	DATE
Taber Abrasor		

PVC

H-18 wheels / 500 cycles 1000 gms weight

Weight loss - .09356 gms.

ENVIRONMENT DURING TEST	DATA APPROVED BY NAME	TITLE	DATE
RESULTS RECORDED BY			

FORM NO. [illegible]

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ILC DOVER
BOX 266-FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 05X-3 0249-05

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED VISOR MATERIAL	X29-893-X00	9/05/80

4. TITLE	5. ARTICLE DESCRIPTION
MATERIAL EVALUATION	LDPE

6. TEST DESCRIPTION

Tensile - FED-STD-406 Method 1013
Elongation - FED-STD-406 Method 1013
Tear - FED-STD-406 Method 1121

7. TEST PROCEDURE ATTACHED
☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED
☐ YES ☒ NO

9. DATE RESULTS NEEDED
9/12/80

10 ORIGINATOR
Bob Algera

TEST COORDINATOR

PRIORITY	WITNESS	YES	NO
	Originator		
	Coordinator		
TEST LEVEL			

COMMENTS

Q & R REVIEW

Q&R WITNESS ☒ YES ☐ NO

DCASR WITNESS ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION ☒ YES ☐ NO

COMMENTS

Reviewed By	Date

TEST CONDUCTOR

SCHEDULE	APPROVAL TC	APPROVAL Q&R
DATE		
TIME		

COMMENTS

FORM NO 2013 (9/79) White - Test Lab Yellow - Test Lab Pink - Originator PRINTED IN USA

ILC DOVER
BOX 266 - FREDERICA, DE. 19946

TEST RESULTS

TEST NUMBER

PROJECT NAME	CHARGE NUMBER	DATE
Visor	X29-893-500	9/05/80

TEST EQUIPMENT USED	CALIBRATION OF TEST EQUIPMENT	
	VERIFIED BY	DATE
Instron		

PHYSICAL TEST REPORT

IDENTIFICATION: LDPE

CURE DATE:

	GAUGE	MODULUS						ULTIMATE TENSILE		ULTIMATE ELONGATION
	MILS	FORCE	PSI	FORCE	PSI	FORCE	PSI	FORCE	PSI	(%)
1	16.5							98	5939	72
2	16.7							108	6467	63
3	16.7							106	6347	72
4	16.8							109	6488	63
5	15.9							106	6667	48
AVG.									6382	64
REQD.										

COMMENTS

	GAUGE	TEAR RESISTANCE		DUROMETER SHORE "A"		TENSION SET	
	MILS	FORCE	PPI				
1	16.3	13.5	828	LEFT		1	
2	17.0	14.0	824	RIGHT		2	
3	16.9	13.5	799			3	
				REQD.		4	
AVG.			817			5	
REQD.							

ENVIRONMENT DURING TEST: 75 Degrees 50 % Relative Humidity

DATA APPROVED BY: NAME TITLE DATE

RESULTS RECORDED BY

ILC DOVER
BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 05X-3 0249-03

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED VISOR MATERIAL	X29-893-X00	09/05/80

4. TITLE	5. ARTICLE DESCRIPTION
COLD CRACK	LDPE

6. TEST DESCRIPTION

Cold Crack per ASTM-D-1790 at -20°F. If cracks occur run at -5°F.

7. TEST PROCEDURE ATTACHED ☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED ☐ YES ☒ NO

9. DATE RESULTS NEEDED 9/12/80

10. ORIGINATOR Bob Algera

TEST COORDINATOR

PRIORITY	WITNESS	YES	NO
	Originator		
	Coordinator		

TEST LEVEL

COMMENTS

Q & R REVIEW

Q&R WITNESS ☒ YES ☐ NO

QCASR WITNESS ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION ☒ YES ☐ NO

COMMENTS

Reviewed By	Date

TEST CONDUCTOR

SCHEDULE	APPROVAL TC	APPROVAL Q&R
DATE		
TIME		

COMMENTS

FORM NO 2913 (9/79) White - Test Lab Yellow - Test Lab Pink - Originator PRINTED IN USA

ILC DOVER BOX 266 - FREDERICA, DE. 19946	TEST RESULTS	TEST NUMBER 05X-3 0249-03
PROJECT NAME	CHARGE NUMBER	DATE
Visor	029-893-500	9/06/80
TEST EQUIPMENT USED	CALIBRATION OF TEST EQUIPMENT	
	VERIFIED BY	DATE
Missimer Chamber		

LDPE Visor Material

Samples (2 each) Tested @ -20°F - both failed.

Samples (1 each) @ -5°F - Sample failed.

ENVIRONMENT DURING TEST

DATA APPROVED BY

NAME TITLE DATE

RESULTS RECORDED BY

PRINTED NAME

ILC DOVER

BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 05X-3 0249-04

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED VISOR MATERIALS	X29-893-X00	9/05/80

4. TITLE	5. ARTICLE DESCRIPTION
MATERAIL EVALUATION	Polyester

6. TEST DESCRIPTION

Tensile - FED-STD-406 Meth 1013

Elongation - FED-STD-406 Meth 1013

Tear - FED-STD-406 Meth 1121

7. TEST PROCEDURE ATTACHED: ☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED: ☐ YES ☒ NO

9. DATE RESULTS NEEDED: 9/12/80

10. ORIGINATOR: Bob Algera

TEST COORDINATOR

PRIORITY	WITNESS	YES	NO
	Originator		
	Coordinator		

TEST LEVEL

COMMENTS

Q & R REVIEW

Q&R WITNESS: ☒ YES ☐ NO

DCASR WITNESS: ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION: ☒ YES ☐ NO

COMMENTS

Reviewed By	Date

TEST CONDUCTOR

SCHEDULE	APPROVAL	
	TC	Q&R
DATE		
TIME		

COMMENTS

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TEST RESULTS

TEST NUMBER

PROJECT NAME	CHARGE NUMBER	DATE
Visor	X29-893-500	9/04/80

TEST EQUIPMENT USED

Instron

CALIBRATION OF TEST EQUIPMENT

VERIFIED BY	DATE

PHYSICAL TEST REPORT

IDENTIFICATION: Polyester

CURE DATE:

	GAUGE	MODULUS						ULTIMATE TENSILE		ULTIMATE ELONGATION
	MILS	FORCE	PSI	FORCE	PSI	FORCE	PSI	FORCE	PSI	(%)
1	43.7							325	7437	20
2	43.2							325	7523	20
3	43.0							320	7442	20
4	42.2							315	7465	20
5	41.5							315	7590	20
AVG.									7491	20
REQD.										

COMMENTS

	GAUGE	TEAR RESISTANCE		DUROMETER SHORE "A"		TENSION SET	
	MILS	FORCE	PPI				
1	48.7	50	1027	LEFT		1	
2	45.7	56	1225	RIGHT		2	
3	44.3	61	1377			3	
				REQD.		4	
AVG.			1210			5	
REQD.							

ENVIRONMENT DURING TEST

75 Degrees F 50 % Relative Humidity

RESULTS RECORDED BY

DATA APPROVED BY

NAME	TITLE	DATE

ILC DOVER

BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 05X-3 0249-02

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED VISOR MATERIAL	X29-893-X00	09/05/80

4. TITLE

COLD CRACK

5. ARTICLE DESCRIPTION

Polyester

6. TEST DESCRIPTION

Cold Crack Test per ASTM-D-1790 at -20°F if cracks occur

7. TEST PROCEDURE ATTACHED

☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED

☐ YES ☒ NO

9. DATE RESULTS NEEDED

9/12/80

10 ORIGINATOR

Bob Algera

TEST COORDINATOR

PRIORITY	WITNESS	YES	NO
	Originator		
	Coordinator		
TEST LEVEL			

COMMENTS

Q & R REVIEW

Q&R WITNESS ☐ YES ☒ NO

DCASR WITNESS ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION ☒ YES ☐ NO

COMMENTS

Reviewed By	Date

TEST CONDUCTOR

SCHEDULE	APPROVAL	
	TC	Q&R
DATE		
TIME		

COMMENTS

ILC DOVER BOX 266 - FREDERICA, DE. 19946	TEST RESULTS	TEST NUMBER 05X-3 0249-02
PROJECT NAME	CHARGE NUMBER	DATE
Visor	29-893-500	9/06/80
TEST EQUIPMENT USED	CALIBRATION OF TEST EQUIPMENT VERIFIED BY	DATE
Missimer Chamber		

Polyester Visor Material

Samples (2 each) tested @ -20°F - both failed.

Samples (2 each) @ -5°F - both failed.

ENVIRONMENT DURING TEST	DATA APPROVED BY NAME	TITLE	DATE
RESULTS RECORDED BY			

FORM NO. [illegible]

PRINTED NAME

ILC DOVER
BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 0247-02

1. PROJECT NAME: IMPROVED VISOR MATERIAL

2. CHARGE NUMBER: X29-893-X00

3. DATE: 9/02/80

4. TITLE: MATERIAL EVALUATION

5. ARTICLE DESCRIPTION: Cellulose Acetate

6. TEST DESCRIPTION:

Tensile - FED-STD-406 Method 1013
Elongation - FED-STD-406 Method 1013
Tear - FED-STD-406 Method 1121

7. TEST PROCEDURE ATTACHED: ☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED: ☐ YES ☒ NO

9. DATE RESULTS NEEDED: 9/08/80

10 ORIGINATOR: Bob Algera

TEST COORDINATOR

PRIORITY	WITNESS	YES	NO
	Originator		
	Coordinator		
TEST LEVEL			

COMMENTS:

Q & R REVIEW

Q&R WITNESS: ☒ YES ☐ NO

DCASR WITNESS: ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION: ☒ YES ☐ NO

COMMENTS:

Reviewed By | Date

TEST CONDUCTOR

SCHEDULE	APPROVAL TC	APPROVAL Q&R
DATE		
TIME		

COMMENTS:

FORM NO 2013 (9/79) White - Test Lab Yellow - Test Lab Pink - Originator PRINTED IN USA

ILC DOVER
BOX 266 - FREDERICA, DE. 19946

TEST RESULTS

TEST NUMBER

PROJECT NAME	CHARGE NUMBER	DATE
Visor Material	X29-893-500	9/03/80

TEST EQUIPMENT USED: Instron

CALIBRATION OF TEST EQUIPMENT

VERIFIED BY	DATE

PHYSICAL TEST REPORT

IDENTIFICATION: Cellulose Acetate

CURE DATE:

	GAUGE	MODULUS						ULTIMATE TENSILE		ULTIMATE ELONGATION
	MILS	FORCE	PSI	FORCE	PSI	FORCE	PSI	FORCE	PSI	(%)
1	30.7							150	4886	60
2	29.6							155	5237	84
3	31.5							155	4921	72
4	30.7							175	5700	100
5	31.8							165	5189	88
AVG.									5187	84.8
REQD.										

COMMENTS

	GAUGE	TEAR RESISTANCE		DUROMETER SHORE "A"		TENSION SET	
	MILS	FORCE	PPI				
1	33.5	21.0	627	LEFT		1	
2	33.8	18.5	547	RIGHT		2	
3	32.8	19.0	579			3	
				REQD.		4	
AVG.			584			5	
REQD.							

ENVIRONMENT DURING TEST: 75 Degrees 50 % Relative Humidity

RESULTS RECORDED BY

DATA APPROVED BY

NAME	TITLE	DATE

ILC DOVER

BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

"ES" NUMBER: 0247-01

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED VISOR MATERIAL	X29-893-X00	9/02/80

4. TITLE	5. ARTICLE DESCRIPTION
COLD CRACK	Cellulose Acetate

6. TEST DESCRIPTION

Run Cold Crack Test per ASTM-D-1790 at -20°F. If cracks occur run at -5°F.

7. TEST PROCEDURE ATTACHED ☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED ☐ YES ☒ NO

9. DATE RESULTS NEEDED 9/08/80

10. ORIGINATOR Bob Algera

TEST COORDINATOR

PRIORITY

TEST LEVEL

WITNESS	YES	NO
Originator		
Coordinator		

COMMENTS

Q & R REVIEW

Q&R WITNESS ☒ YES ☐ NO

DCASR WITNESS ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION ☒ YES ☐ NO

COMMENTS

Reviewed By	Date

TEST CONDUCTOR

SCHEDULE	APPROVAL	
	TC	Q&R
DATE		
TIME		

COMMENTS

FORM NO 2013 (9/79) White - Test Lab Yellow - Test Lab Pink - Originator PRINTED IN USA

ILC DOVER BOX 266 - FREDERICA, DE. 19946	TEST RESULTS	TEST NUMBER 0247-01
PROJECT NAME	CHARGE NUMBER	DATE
Visor Material	X29-893-500	9/3/80
TEST EQUIPMENT USED	CALIBRATION OF TEST EQUIPMENT VERIFIED BY	DATE
Missimer Cold Chamber		

Samples (2 each) @ - 20°F - both failed

Samples (2 each) @ -5°F - both failed.

ENVIRONMENT DURING TEST	DATA APPROVED BY NAME	TITLE	DATE
RESULTS PROCESSED BY			

ILC DOVER
BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 05X-01 0269-09

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED VISOR MATERIAL	X29-893-X00	9/23/80

4. TITLE	5. ARTICLE DESCRIPTION
SEAM TEST	CPE - Surlyn Heat Seam

6. TEST DESCRIPTION

Run Shear Tests on CPE - Surlyn seams. Record shear strength of each sample of A, B, & C configuration. Return samples to Bob Algera

7. TEST PROCEDURE ATTACHED: ☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED: ☐ YES ☒ NO

9. DATE RESULTS NEEDED: 9/31/80

10 ORIGINATOR: Bob Algera

TEST COORDINATOR

PRIORITY	WITNESS	YES	NO
	Originator		
	Coordinator		

TEST LEVEL

COMMENTS

Q & R REVIEW

Q&R WITNESS: ☐ YES ☒ NO

DCASR WITNESS: ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION: ☒ YES ☐ NO

COMMENTS

Reviewed By	Date

TEST CONDUCTOR

SCHEDULE	APPROVAL TC	APPROVAL Q&R
DATE		
TIME		

COMMENTS

FORM NO 2013 (9/79) White - Test Lab Yellow - Test Lab Pink - Originator PRINTED IN USA

ILC DOVER BOX 266 - FREDERICA, DE. 19946	TEST RESULTS	TEST NUMBER 05X-1 0269-09
PROJECT NAME	CHARGE NUMBER	DATE
Improved Visor Material	X29-893-500	9/24/80
TEST EQUIPMENT USED	CALIBRATION OF TEST EQUIPMENT VERIFIED BY	DATE
Instron		

A) Single Lap Seam
B) Double Lap Seam
C) Double Lap Seam w/ Holes in Surlyn

Sample

A - 1) 47 lbs/in. (CPE failed below the seam on all samples)
2) 47 "
3) 48 "
4) 47 "
5) 49 "

47.6 lbs/in. Average

B - 1) 46 lbs/in. (CPE failed at bead on lower seam)
2) 47 " (CPE failed at bead on lower seam)
3) 39* " (CPE failed at bead on lower seam)
4) 42* " (CPE failed at bead on lower seam)
5) 37* " (CPE failed below the seam area)

42.2 lbs/in. Average

C - 1) 28* lbs/in. (CPE failed at the bead on lower seam on all samples)
2) 37* "
3) 39* "
4) 35* "
5) 34* " 34.6 lbs/in. Average

*NOTE: CPE appeared to be in transverse direction on these samples possible causing low values.

ENVIRONMENTAL CONDITIONS TEST

50 %Relitive Humidity 75 Degrees F

DATA APPROVED BY

NAME	TITLE	DATE

RESULTS RECORDED BY

FORM NO. [illegible]

PRINTED [illegible]

ILC DOVER
BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 05X-1 0294-03

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED VISOR MATERIAL	X29-893-X00	10/15/80

4. TITLE	5. ARTICLE DESCRIPTION
PEEL TEST	CPE - Surlyn Seam

6. TEST DESCRIPTION

Run Peel Test on CPE - Surlyn Heat Seal Seam

Return samples to Bob Algera

7. TEST PROCEDURE ATTACHED ☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED ☐ YES ☒ NO

9. DATE RESULTS NEEDED 10/22/80

10. ORIGINATOR Bob Algera

TEST COORDINATOR

PRIORITY

WITNESS	YES	NO
Originator		
Coordinator		

TEST LEVEL

COMMENTS

Q & R REVIEW

Q&R WITNESS ☐ YES ☒ NO

DCASR WITNESS ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION ☒ YES ☐ NO

COMMENTS

Reviewed By	Date

TEST CONDUCTOR

SCHEDULE	APPROVAL TC	APPROVAL Q&R
DATE		
TIME		

COMMENTS

ILC DOVER BOX 266 - FREDERICA, DE. 19946	TEST RESULTS	TEST NUMBER 05X-1 0294-03
PROJECT NAME	CHARGE NUMBER	DATE
Visor Material	X29-893-500	10/22/80
TEST EQUIPMENT USED	CALIBRATION OF TEST EQUIPMENT VERIFIED BY	DATE
Instron		

Peel Test CPE - Surly Seam

Samples #

1) 23 lbs/in.
2) 21 "
3) 20 "
4) 24 "

22 lbs/in. Average

ENVIRONMENT DURING TEST	DATA APPROVED BY NAME / TITLE / DATE
RESULTS RECORDED BY	

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ILC DOVER
BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

"ES" NUMBER: 05X-1 0294-04

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED VISOR MATERIAL	X29-893-X00	10/15/80

4. TITLE	5. ARTICLE DESCRIPTION
ACCEL AGING TEST	CPE - Surlyn

6. TEST DESCRIPTION

1. Run Acelerated Aging per FED-STD-406, Meth 6011, Proc 7.
2. Run Shear Test on seam after aging.
3. Return samples to Bob Algera

7. TEST PROCEDURE ATTACHED: ☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED: ☐ YES ☒ NO

9. DATE RESULTS NEEDED: 10/22/80

10. ORIGINATOR: Bob Algera

TEST COORDINATOR

PRIORITY

TEST LEVEL

WITNESS	YES	NO
Originator		
Coordinator		

COMMENTS

Q & R REVIEW

Q&R WITNESS: ☐ YES ☒ NO

DCASR WITNESS: ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION: ☒ YES ☐ NO

COMMENTS

Reviewed By | Date

TEST CONDUCTOR

SCHEDULE	APPROVAL TC	APPROVAL Q&R
DATE		
TIME		

COMMENTS

FORM NO 2013 (9/79) White - Test Lab Yellow - Test Lab Pink - Originator PRINTED IN USA

ILC DOVER BOX 266 - FREDERICA, DE. 19946	TEST RESULTS	TEST NUMBER 05X-11 0294-04
PROJECT NAME	CHARGE NUMBER	DATE
Visor Material	X29-893-500	10/24/80
TEST EQUIPMENT USED	CALIBRATION OF TEST EQUIPMENT VERIFIED BY	DATE
Instron		

Acelarated Aging Test

Tensil Test 3 samples

1) 25.5 lbs/in.
2) 27.5 "
3) 29 "

27.3 lbs/in. Average

Samples tested after aging per Fed-Method 406 #6011 Proc. 7.

ENVIRONMENT DURING TEST

DATA APPROVED BY

NAME TITLE DATE

RESULTS RECORDED BY

FORM NO. [illegible]

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ILC DOVER
BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 05X-1 0268-08

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED VISOR MATERIAL	X29-893-X00	9/17/80

4. TITLE	5. ARTICLE DESCRIPTION
SEAM PEEL TEST	Surlyn 1605

6. TEST DESCRIPTION

Run Peel Tests on Surlyn and Vinyl covered Surlyn seam samples. Record peel strength of each sample

7. TEST PROCEDURE ATTACHED ☐ YES ☒ NO

8. PHOTO DOCUMENTATION REQUIRED ☐ YES ☒ NO

9. DATE RESULTS NEEDED

10. ORIGINATOR

TEST COORDINATOR

PRIORITY	WITNESS	YES	NO
	Originator		
	Coordinator		
TEST LEVEL			

COMMENTS

Q & R REVIEW

Q&R WITNESS ☒ YES ☐ NO

DCASR WITNESS ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION ☒ YES ☐ NO

COMMENTS

Reviewed By | Date

TEST CONDUCTOR

SCHEDULE	APPROVAL	
	TC	Q&R
DATE		
TIME		

COMMENTS

FORM NO 2013 (9/79) White - Test Lab Yellow - Test Lab Pink - Originator PRINTED IN USA

ILC DOVER BOX 266 - FREDERICA, DE. 19946	TEST RESULTS	TEST NUMBER 05X-1 0268-08
PROJECT NAME	CHARGE NUMBER	DATE
IMPROVED VISOR MATERIAL	X29-893-500	9/18/80
TEST EQUIPMENT USED	CALIBRATION OF TEST EQUIPMENT VERIFIED BY	DATE
Instron		

Surlyn Seam Peel Test

Samples

A - 1) 66 lbs/in.

A - 2) 40 "

B - 86 "

C - 85 "

ENVIRONMENTAL CONDITIONS DURING TEST

DATA APPROVED BY

NAME TITLE DATE

RESULTS RECORDED BY

PRINTED IN U.S.A.

ATTACHMENT 2

FUNCTIONAL TEST PROGRAM DATA SHEETS

ILC DOVER
BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 893-4 1181-05

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED DPE VISOR MATERIAL	X29-893-X00	30 JUN 81

4. TITLE
Improved DPE Visor Material
Endurance Test

5. ARTICLE DESCRIPTION
DPE Suit W/Surlyn Visor

6. TEST DESCRIPTION
Complete Endurance Test IAW ATCH 1.

7. TEST PROCEDURE ATTACHED
☒ YES ☐ NO

8. PHOTO DOCUMENTATION REQUIRED
☐ YES ☒ NO

9. DATE RESULTS NEEDED
17 July 81

10. ORIGINATOR
Dale Barr

TEST COORDINATOR

PRIORITY	WITNESS	YES	NO
	Originator	✓	
	Coordinator		✓

TEST LEVEL			

COMMENTS

Q & R REVIEW

Q&R WITNESS ☐ YES ☒ NO

DCASR WITNESS ☐ YES ☒ NO

Q&R CALIBRATION VERIFICATION ☒ YES ☐ NO

COMMENTS

Reviewed By	Date
DB	6/30/81

TEST CONDUCTOR

SCHEDULE	APPROVAL TC	APPROVAL Q&R
DATE		
TIME		

COMMENTS

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IMPROVED DPE VISOR MATERIAL
ENDURANCE TEST PLAN

Purpose

The endurance test will be conducted to determine the reliability of the improved visor material in the DPE configuration. The endurance test will consist of two parts: A manned test using a complete DPE system, and an impact test on the visor seams.

Procedure

The manned endurance test will consist of a ten minute exercise period and five minute rest period repeated 24 times for a total test time of six hours to verify that the improved visor material and the attachment seams will last for the two hour duty cycle used at CAMDS. The exercises to be done are:

1. Turn head left and right - 5 times.
2. Bend head forward and back - 5 times.
3. Bend head left and right - 5 times.
4. Raise arms over head and down to sides - 5 times.
5. Move arms forward and backward - 5 times.
6. Move arms in a circular motion - 5 times.
7. Duck squat and fold arms across chest.
8. Reseat face mask by grasping through visor.

Repeat exercises for ten minutes and rest for five minutes. Check all visor and attachment seams for leaks after each 10 minute exercise period. The test subjects may be alternated or take an extended rest outside the suit at the discretion of the test coordinator.

The exercises are selected to stimulate the loading on the visor and visor/helmet attachment seams likely to be encountered during normal usage.

ILC DOVER
BOX 266 - FREDERICA, DE 19946

TEST RESULTS

TEST NUMBER
893-4
1181-05

TEST NAME	CHARGE NUMBER	DATE
IMPROVED DPE VISOR MATERIAL	X29-893-X00	8-27-81

TEST EQUIPMENT USED	CALIBRATION OF TEST EQUIPMENT	
	VERIFIED BY	DATE

ENDURANCE TEST

#6		Cycles	
Art			
1:56 - 2:06		~~1111 1111~~ 11	No Leaks
2:06 - 2:11	Break		
2:11 - 2:21		~~1111 1111~~ 111	No Leaks
2:21 - 2:26	Break		
2:26 - 2:36		~~1111 1111~~ 11	No Leaks
2:36 - 2:41	Break		
2:41 - 2:51		~~1111 1111~~ 111	No Leaks

ENVIRONMENTAL CONDITIONS DURING TEST

DATA APPROVED BY

NAME	TITLE	DATE

RESULTS RECORDED BY

McClain

SIGNATURE

PRINTED NAME

ILC DOVER

BOX 266 - FREDERICA, DE 19946

TEST RESULTS

TEST NUMBER
893-4
1181-05

TEST NAME	CHARGE NUMBER	DATE
IMPROVED DPE VISOR MATERIAL	X29-893-X00	8-27-81

TEST EQUIPMENT USED

CALIBRATION OF TEST EQUIPMENT	
VERIFIED BY	DATE

ENDURANCE TEST

#4

MARK			CYCLES	
9:57	10:07		~~1111 1111~~ 1	No Leaks
10:07	10:12	Break		
10:12	10:22		~~1111 1111~~	No Leaks
10:22	10:27	Break		
10:27	10:37		~~1111 1111~~ 1	No Leaks
10:37	10:42	Break		
10:42	10:57		~~1111~~ ~~1111~~ 1	No Leaks

#5

MARK				
12:41	12:51		~~1111 1111~~ 1	No Leaks
12:51	12:56	Break		
12:56	1:06		~~1111 1111~~ 111	No Leaks
1:06	1:16	Break		
1:11	1:21		~~1111 1111~~ 11	No Leaks
1:21	1:26	Break		
1:26	1:36		~~1111 1111~~ 1	No Leak

TEST CONDUCTED BY

DATA APPROVED BY

NAME	TITLE	DATE

DATA RECORDED BY

McClain

SIGNATURE OF AUTHOR

SIGNATURE

ILC DOVER BOX 266 - FREDERICA, DE 19946	TEST RESULTS	TEST NUMBER 893-4 1181-05
TEST ITEM NAME	CHARGE NUMBER	DATE
IMPROVED DPE VISOR MATERIAL	X29-893-X00	8-21-81
TEST EQUIPMENT USED	CALIBRATION OF TEST EQUIPMENT VERIFIED BY	DATE

ENDURANCE TEST

Art

				No Leaks
3)	8:24	8:34	~~1111~~ 1111	No Leaks
	8:34	8:39	Break	
	8:39	8:49	~~1111~~ ~~1111~~	No Leaks
	8:49	8:54	Break	
	8:54	9:04	~~1111~~ 111	No Leaks
	9:04	9:09	Break	
	9:09	9:19	~~1111~~ ~~1111~~	

ENVIRONMENTAL CONDITIONS DURING TEST

DATA APPROVED BY

NAME TITLE DATE

TEST DATA RECORDED BY

McClain

SIGNATURE OF RECORDER

SIGNATURE

ILC DOVER BOX 266 - FREDERICA, DE 19946	TEST RESULTS	TEST NUMBER 893-4 1181-05
TEST ITEM NAME	CHANGE NUMBER	DATE
IMPROVED DPE VISOR MATERIAL	X29-893-X00	8-20-81
TEST EQUIPMENT USED	CALIBRATION OF TEST EQUIPMENT VERIFIED BY	DATE

1:30 ENDURANCE TEST

Art 8/20/81

1)	No Leakage on Visor		Cycles	
	1:45 - 1:55		~~1111~~ 11	No Leaks
	1:40 - 1:55	Break		
	1:55 - 2:05		~~1111~~ 11	No Leaks
	2:05 - 2:10	Break		
	2:10 - 2:20		~~1111~~ 111	No Leaks
	2:20 - 2:25	Break		
	2:25 - 2:40		~~1111~~ 11	No Leaks

Mark 8/20/81

2)	3:10	3:20		~~1111~~ 11	No Leaks
	3:20	3:25	Break		
	3:25	3:35		~~1111~~ 111	No Leaks
	3:35	3:40	Break		
	3:40	3:50		~~1111~~ 1111	No Leaks
	3:50	3:55	Break		
	3:55	4:10	(2 min.)	11	
			Seat of suit core		
	8/21/81	8:35 - 8:45		~~1111~~ 111	No Leaks

ENVIRONMENT DURING TEST

DATA APPROVED BY

NAME TITLE DATE

TEST DATA RECORDED BY

McClain

PRINTED NAME

ILC DOVER

BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 893-4 / 1243-01

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED DPE	X29-893-00	31 Aug 81

4. TITLE	5. ARTICLE DESCRIPTION
IMPROVED DPE VISOR MATERIAL BURST TEST	DPE Suit W/ Surlyn Visor

6. TEST DESCRIPTION

Inflate suit to burst.
Record Results identify burst area

7. TEST PROCEDURE ATTACHED

☐ YES ☐ NO

8. PHOTO DOCUMENTATION REQUIRED

☐ YES ☐ NO

9. DATE RESULTS NEEDED

2 SEP 81

10. ORIGINATOR

Dale Barr

TEST COORDINATOR

PRIORITY	WITNESS	YES	NO
	Originator		
	Coordinator		

TEST LEVEL			

COMMENTS

Q & R REVIEW

Q&R WITNESS ☐ YES ☐ NO

QCASR WITNESS ☐ YES ☐ NO

Q&R CALIBRATION VERIFICATION ☐ YES ☐ NO

COMMENTS

Reviewed By	Date

TEST CONDUCTOR

SCHEDULE	APPROVAL	
	TC	Q&R
DATE		
TIME		

COMMENTS

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TEST RESULTS

TEST NUMBER
893-4
1243-01

PROJECT NAME	CHARGE NUMBER	DATE
IMPROVED D.P.E.	X29-893-X00	9/3/81

TEST EQUIPMENT USED	CALIBRATION OF TEST EQUIPMENT	
	VERIFIED BY	DATE
Sanborn & Transducer	DB	2/13/81

Pressurized suit to 21" H^2O. Failure of seam; left shoulder seam.

ENVIRONMENT DURING TEST
Rm Ambient

DATA APPROVED BY

NAME	TITLE	DATE

RESULTS RECORDED BY
D. Beyer

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BOX 266 - FREDERICA, DE. 19946

TEST REQUEST

TEST NUMBER: 893-1 1181-04

1. PROJECT NAME	2. CHARGE NUMBER	3. DATE
IMPROVED DPE VISOR MATERIAL	X-29-893-X00	8/16/81

4. TITLE	5. ARTICLE DESCRIPTION
VISOR IMPACT TEST	DPE Visor Assembly with Surlyn Visor

6. TEST DESCRIPTION
Run Visor impact test IAW attached procedure

7. TEST PROCEDURE ATTACHED ☒ YES ☐ NO

8. PHOTO DOCUMENTATION REQUIRED ☐ YES ☒ NO

9. DATE RESULTS NEEDED
8/18/81

10. ORIGINATOR
Bob Algera

TEST COORDINATOR

PRIORITY

TEST LEVEL

WITNESS	YES	NO
Originator		
Coordinator		

COMMENTS

Q & R REVIEW

Q&R WITNESS ☐ YES ☐ NO

DCASR WITNESS ☐ YES ☐ NO

Q&R CALIBRATION VERIFICATION ☐ YES ☐ NO

COMMENTS

Reviewed By	Date

TEST CONDUCTOR

SCHEDULE	APPROVAL	
	TC	Q&R
DATE		
TIME		

COMMENTS

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VISOR IMPACT TEST PROCEDURE

1. Pressurize Test Helmet to .6 iwg and maintain pressure
2. Impact peak of visor with impact fixture
3. Check for leaks every 100 impacts to 500 and every 500 thereafter
4. Conclude test after 2000 impacts or at failure

ILC DOVER
BOX 266 - FREDERICA, DE 19946

TEST RESULTS

TEST NUMBER
893-1
1181-04

IMPROVED DPE VISOR MATERIAL	X29-893-00	18 Aug 81

TEST EQUIPMENT USED

CALIBRATION OF TEST EQUIPMENT

VERIFIED BY	DATE

Inflate hood assy. to 6" H^2O pressure. Drop 13.5 lbs. 3/4". Record Results.

IMPACTS	RESULTS
0	No leakage
100	"
250	"
500	"
1000	"
1500	"
2000	"

DATA APPROVED BY

NAME	TITLE	DATE